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ABSTRACT

This circular provides current information for homeowners who must repair or replace existing on-lot sewage disposal systems. Several alternatives such as elevated sand mounds, sand-lined beds and trenches and oversized absorption areas are discussed. Site characteristics and preparation are outlined. Each alternative is accompanied by a diagram indicating construction requirements. (CS)

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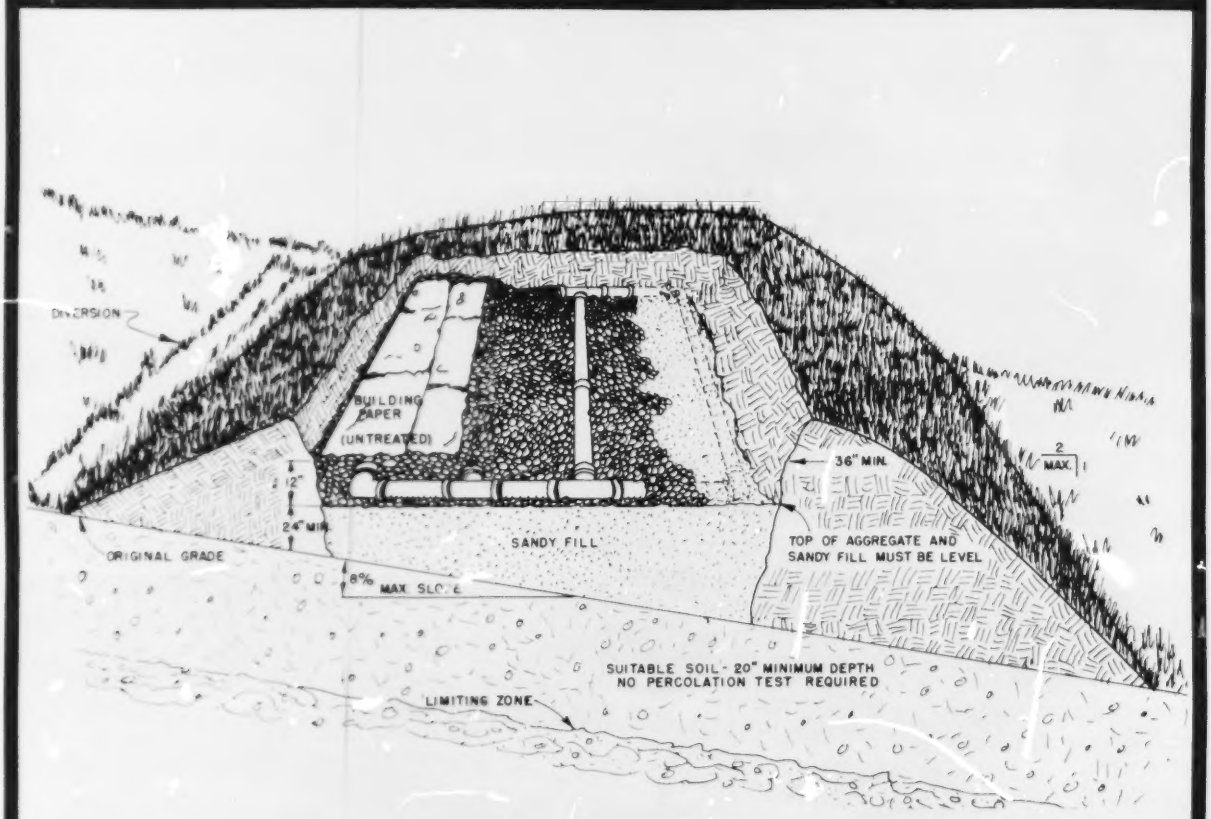
Special Circular 214

ALTERNATE METHODS OF EFFLUENT DISPOSAL FOR ON-LOT HOME SEWAGE SYSTEMS



Cooperative Extension Service / College of Agriculture
The Pennsylvania State University / University Park, Pennsylvania

SE 023 981

Recent amendments to Pennsylvania Sewage Facilities Act (Act 537) have enabled the Department of Environmental Resources (DER) to change various rules and regulations governing the design and installation of individual on-lot sewage disposal systems. These revised regulations, authorized by Act 208 and published in Chapter 71, Administration of Sewage Facilities Program, and in Chapter 73, Standards for Sewage Disposal facilities, became effective on September 16, 1974.

Homeowners who must repair or replace existing sewage disposal systems and potential homeowners who plan to purchase lots for new homes should become familiar with these regulations before they purchase a lot or start to repair an existing system. Copies of the regulations can be obtained by writing to the Office of Public Information, Department of Environmental Resources, P.O. Box 2063, Harrisburg, Pennsylvania, 17120, or a county office of DER.

This publication supplements the information published in Penn State's Special Circular 212, entitled, "Home Sewage Disposal." It does not contain all of the details spelled out in the Chapters 71 and 73 of the rules and regulations, but it does provide information that may help home builders and potential home owners develop plans for on-lot sewage disposal systems in problem situations.

N. Henry Woodling, Extension Agricultural Engineer

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Alternate Methods of Effluent Disposal for On-Lot Home Sewage Systems

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SEWAGE DISPOSAL PERMITS REQUIRED

Sewage disposal permits are required for all individual on-site home sewage disposal systems except "rural residences" as defined in the law and regulations. In Pennsylvania, a rural residence is defined as a structure occupied or intended to be occupied by not more than two families on a tract of land of ten acres or more. This exception does not apply in those counties, townships, boroughs that have enacted ordinances requiring permits for *all* on-site disposal facilities (including rural residences).

Permits must be issued by a certified Sewage Enforcement Officer (SEO). This person must pass a written examination, be certified by DER's Certification Board, and be authorized by municipal ordinance or resolution to issue permits in the municipality concerned.

Applications for permits can be obtained from the municipal office or the Local Agency Sewage Enforcement Officer. A local agency means a municipality, or any combination of municipalities acting cooperatively or jointly under the laws of the Commonwealth, county, county department of health, or joint county department of health.

ALTERNATE SUBSURFACE ABSORPTION FACILITIES

As revised, the regulations now permit the installation of aerobic treatment tanks that meet the requirements of "Standard 40" of the National Sanitation Foundation (NSF), dated November 13, 1970. They also permit the use of alternate effluent disposal systems including *elevated sand mounds, sand-lined trenches and beds, oversize areas,* and *shallow placement areas.*

Use of the alternate systems is restricted to those specific situations where soil and topographic conditions are suitable. These situations together with the appropriate alternatives are portrayed in a "Matrix For Adaptation of Alternate Subsurface Absorption Areas" on page 12. In the case of isolated buildings or new residences, there must be sufficient suitable area for the replacement of the alternative absorption area with another of equivalent size and design.

ABSORPTiON AREA SUITABILITY

Soil characteristics, slope, and subsurface limiting zones are primary factors that regulate the type of effluent absorption area that is suitable for a given site.

The following table summarizes the types of absorption areas that are usually acceptable based on the depth of the limiting zone and the natural slope.

Depth of Limiting Zone (inches)	Natural Slope (percent)	Absorption Area
72 and deeper	0 to 8	Standard Seepage Bed
	0 to 25	Standard Trenches
	0 to 25	Serial Distribution
Between 60 and 72	0 to 5	Shallow Placement Seepage Bed
	0 to 15	Shallow Placement Trenches
	0 to 20	Shallow Placement Serial Distribution
Between 20 and 60	0 to 8	Elevated Sand Mound Seepage Bed
	0 to 12	Elevated Sand Mound With Modified Trench
Less than 20	---------	Unsuitable

ELEVATED SAND MOUND

An elevated sand mound (Fig. 1) is simply a mound of sandy fill material placed on the surface of the ground at a site approved for its use. This sandy fill material serves as a physical and biological medium in which the sewage effluent is filtered and treated before it is absorbed by the natural soil.

Permissible Soil and Site Conditions

An elevated sand mound may be used when soil conditions prohibit the use of conventional subsurface tile fields and seepage beds. It may also be used to correct an existing malfunctioning disposal field, provided all of the requirements or limitations indicated below are met.

Non-permissible Conditions

It cannot be used on a flood plain soil or any soil that is considered to be somewhat poorly, poorly, or very poorly drained. It cannot be used where the limiting zone (seasonal water table, rock formation, or impervious strata) occurs within 20 inches of the soil surface. *A percolation test on the site is not required.*

The maximum natural slope on which an elevated sand mound using seepage bed distribution can be constructed is 8 percent. If the mound uses a trench distribution system, a maximum slope of 12 percent is acceptable. The area surrounding the mound must be graded to divert surface runoff water from the site.

Site Preparation

The layer of organic material covering the site selected for the mound should be removed. Organic material, if left in place, may cause the sandy fill to settle unevenly.

If the site has been previously graded and soil removed, the depth to the limiting zone must be measured from the surface of

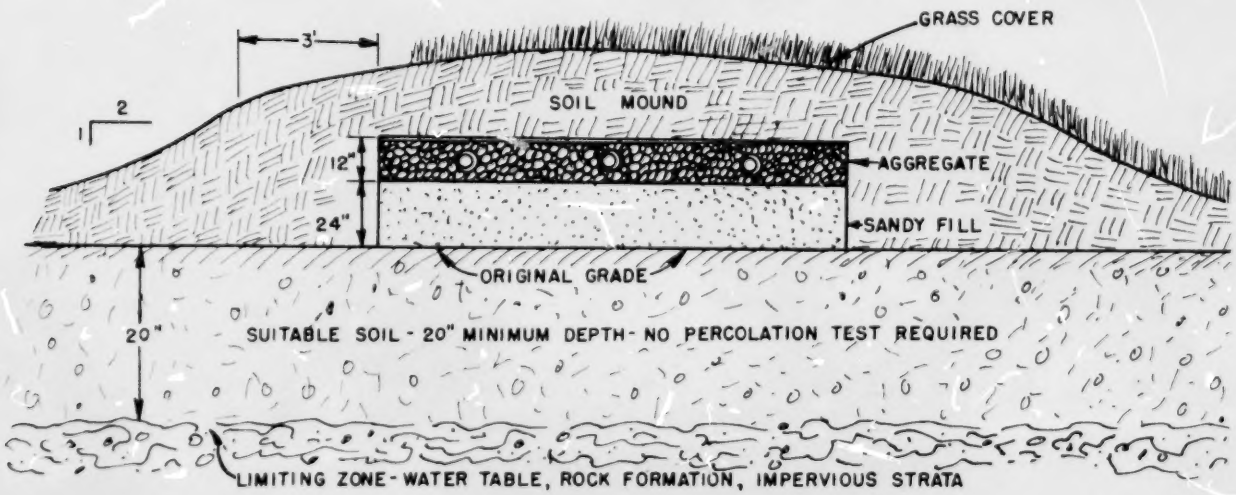
Fig. 1. ELEVATED SAND MOUND — SEEPAGE BED DISTRIBUTION

Permissible Uses and Site Characteristics

1. New construction
2. Correct existing malfunctioning system
3. Limiting zone — 20 inches below surface (minimum)
4. Maximum natural slope — 8 percent

Non-Permissible Site Conditions

1. Flood plains (Soils group 13)
2. Poorly drained, high water table (Soils group 15)
3. Filled areas (fill in place less than 4 years)



the bare finished grade. If earth fill has been deposited on the site during the preceding 48 months, the surface of the original undisturbed soil must be used as the surface from which to measure depth to the limiting zone.

Sand Specifications

Sandy soil used in the construction of an elevated sand mound is very roughly the equivalent of what is known as dirty sand or riverbank sand. When screened through a soil seive, it must fall within the following limits:

— Sandy soil with a single grain or very weak structure must have a clay content 5 to 15 percent by *weight*.
— If the soil is characterized as weak blocky or subangular blocky, the clay content must not exceed 12 percent.
— Coarse fragments larger than one-quarter inch must not exceed 15 percent by volume.

Size of Mound

The effective size of the mound or the absorption area covered by the sand should be calculated on the basis of 330 square feet per bedroom or 1.65 square feet per gallon of effluent per day. If an aerobic tank is used, the basis is 220 square feet per bedroom or 1.10 square feet per gallon per day.

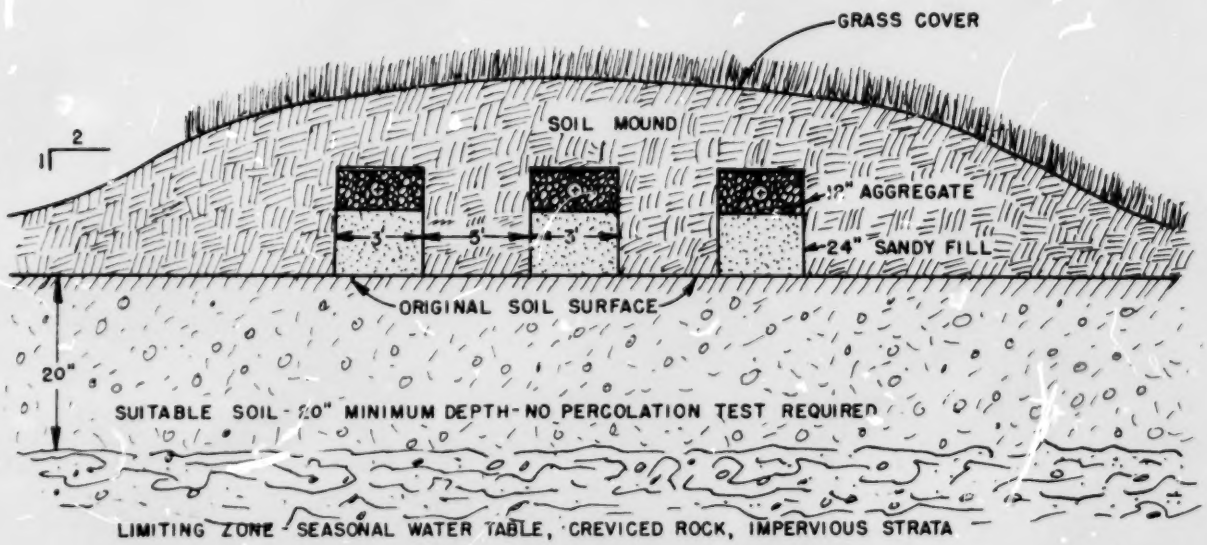
Fig. 2 ELEVATED SAND MOUND — TRENCH DISTRIBUTION

Permissible Uses and Site Characteristics

1. New construction
2. Correct existing malfunctioning system
3. Limiting zone — 20 inches below surface (minimum)
4. Maximum natural slope — 12 percent

Non-Permissible Site Conditions

1. Flood plains (Soils group 13)
2. Poorly drained, high water table (Soils group 15)
3. Filled areas (fill in place less than 4 years)



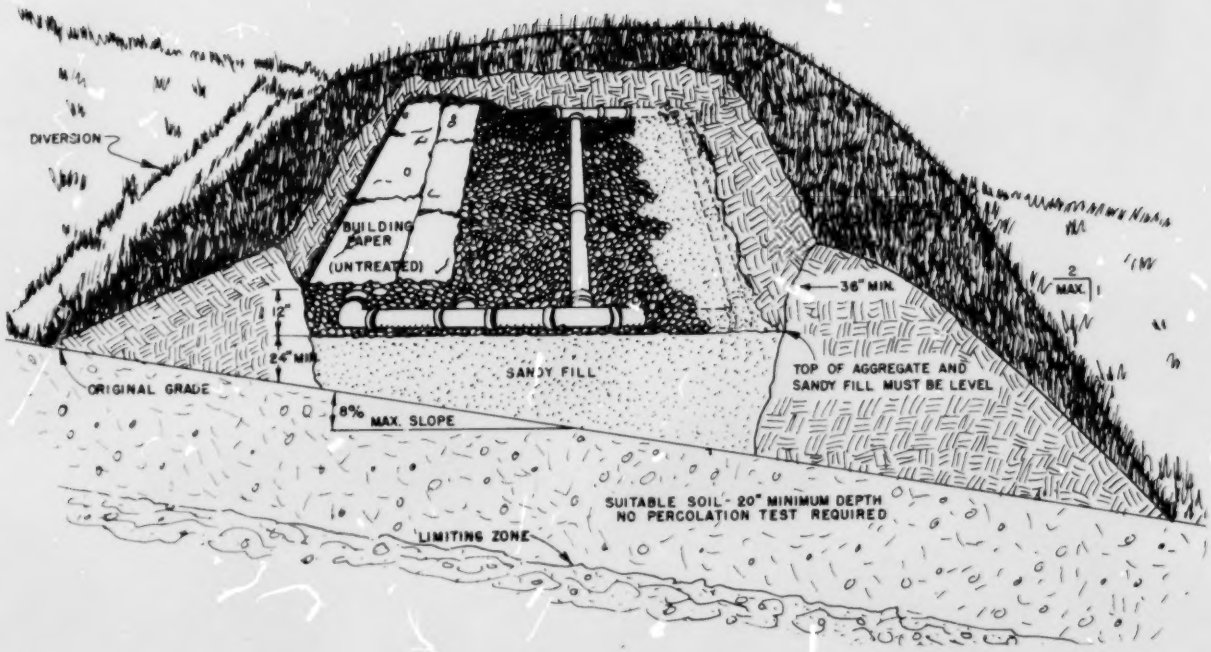
Mound Construction

The depth of sand fill within the mound must be at least 2 feet. The aggregate placed on top of the sand must be 1 foot deep with approximately 6 inches of stone underneath the distribution pipe and 2 inches on top. The pipelines should be approximately 6 feet on center and no closer than 3 feet to edge of the mound or berm. The mound should be covered with at least 1 foot of soil and compacted at the edges to prevent lateral flow. This covering soil should be free of large rock and organic masses. The berm should consist of less permeable soil and should extend at least 3 feet beyond the edge of the fill at the top of the aggregate layer and should not exceed a 2-to-1 slope.

A diagram of an elevated sand mound with distribution trenches instead of the seepage bed is shown in Figure 2.

All other design criteria relating to site conditions, size, and construction for an on-site disposal system remain the same.

Fig. 3 ELEVATED SAND MOUND — SLOPE INSTALLATION SEEPAGE BED



SAND-LINED BEDS AND TRENCHES

This alternate method of effluent disposal differs from an elevated sand mound in that, instead of above-ground location, the sandy fill material is placed in a pit or an excavation below the natural surface (Fig. 4).

Permissible Soil and Site Conditions

This disposal system may be used on sites with very well drained soils where the percolation rate is less than 6 minutes per inch (6 to 60 minutes per inch required for conventional methods) or where the depth to excessively permeable rock fragments or a gravel bed is less than 4 feet below the surface. This method cannot be used on flood plain soils or soils with restrictive permeability.

The natural slope of the site on which sand-lined trenches or beds can be installed varies with method of effluent distribution. Seepage beds may be installed on slopes not exceeding 8 percent, while trenches may be used on sites with slopes ranging up to 25 percent. On slopes ranging from 20 to 25 percent, the system must be designed and the construction supervised by a registered professional engineer with expertise in this field.

Design and Construction

The design and construction of sand-lined trenches and beds must meet the general standards for *standard trenches, serial distribution*, and *seepage beds* (described in Chapter 73, Standards for Sewage Disposal Facilities). In addition, a minimum of 2 feet of sandy fill material meeting the standard required for the elevated sand mound, must be placed under the gravel aggregate

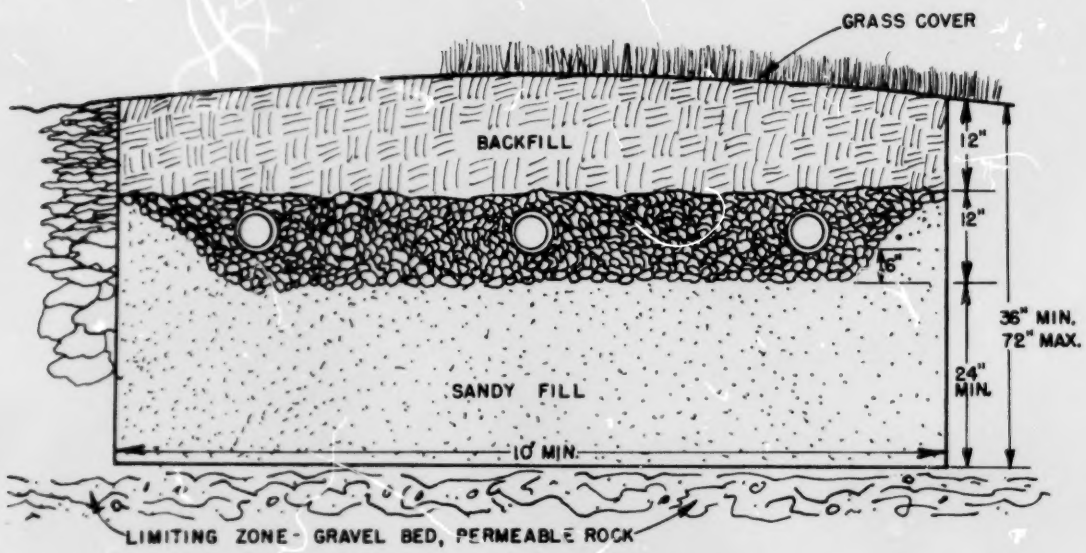
Fig. 4. SAND-LINED BEDS AND TRENCHES

Permissible Soil Characteristics or Site Conditions

1. Sites having percolation rates less than 6 minutes per inch
2. Depth to crevised rock or gravel beds less than 4 feet

Not Permissible

1. Flood plains (Soils group 13)
2. Sites where ground water table or soil mottling appears at less than 4 feet below the bottom of aggregate



(4 feet of sand may be required in some situations). The surface of the sandy fill material must be shaped like a dish with a rim of sand extending upward and beyond the edges of the gravel aggregate as shown in Figure 4. This will prevent unfiltered effluent from flowing down the wall of the excavation.

Depth and Width Dimensions

The minimum depth of the excavation for sand-lined bed or trench is 3 feet and the maximum depth is 6 feet. The bottom width of a trench should be 3 feet and the minimum width of a bed is 10 feet.

Although the minimum depth of 3 feet is required for all trenches and beds, the excavation should not be any deeper than necessary, especially if the soil becomes more porous with increasing depth.

Size of Absorption Area

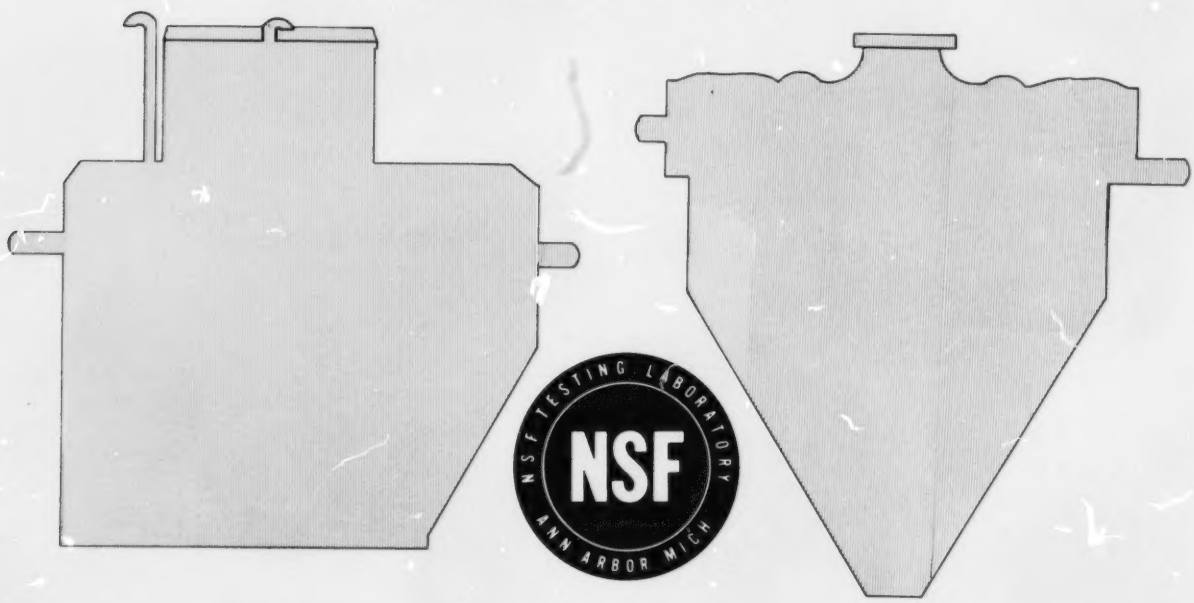
The size of the sand filled absorption area should be calculated on the basis of 330 square feet per bedroom or 1.65 square feet per gallon of effluent per day. If an aerobic tank is used, the size of the absorption area can be reduced to 220 square feet per bedroom or 1.10 square feet per gallon of effluent per day.

AEROBIC SEWAGE TREATMENT STANDARDS

Aerobic sewage treatment tanks or separate components approved for use in Pennsylvania must conform with National Sanitation Foundation Standard 40 dated November 13, 1970, relating to individual aerobic wastewater treatment plants. Such equipment must bear the NSF *Seal of Sanitation Quality* or be approved by the Pennsylvania Department of Environmental Resources based on tests conducted by an approved testing agency in accordance with the procedures specified in Standard 40.

Fig. 5. NSF SEAL

The NSF Seal is a nationally recognized symbol indicating that equipment meets public-health requirements.



OVERSIZED ABSORPTION AREAS

If a conventional effluent-disposal field cannot be permitted on a site because of a slow percolation rate, the oversized absorption area may be considered as an alternate method of disposal (either the standard trench or the serial distribution system may be used).

Soil and Site Considerations

The oversize area can be used only on sites with deep soils like those listed in Soil Group 10 and where the percolation rate is greater than 60 but less than 90 minutes per inch. The limiting zone must be at least 4 feet below the bottom of the gravel aggregate that will be placed in the absorption bed or trench.

Size of Absorption Area

The size of the absorption area for this alternate method of disposal must be based on 425 square feet per bedroom. A septic tank is not permitted, and an aerobic treatment tank is required. The reduction in size of absorption area for aerobic tanks does not apply in this situation.

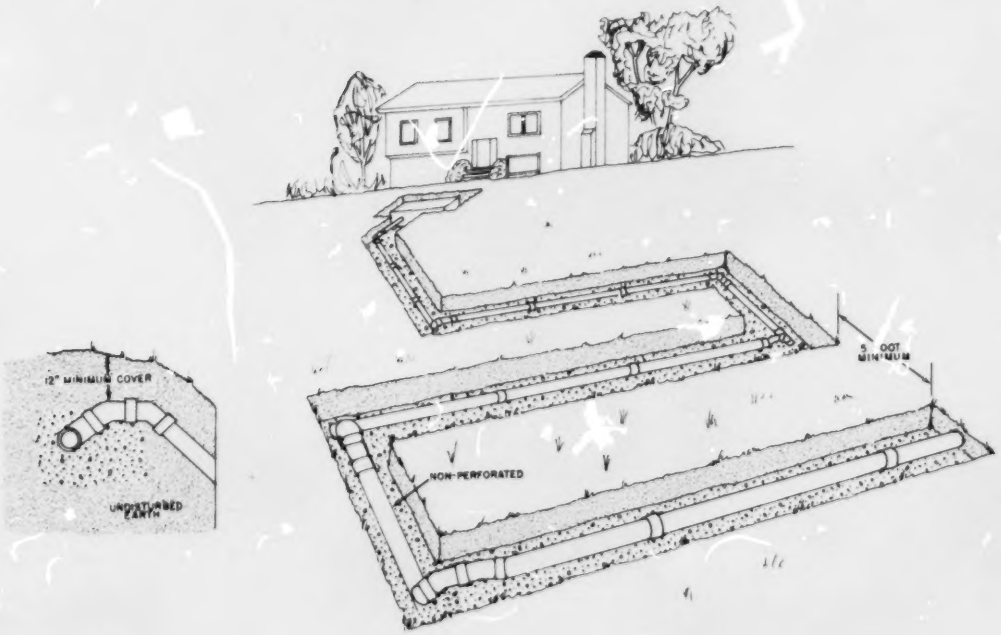
EFFLUENT DISTRIBUTION SYSTEMS

If the *standard trench* distribution system is used, the minimum natural slope of the site must not exceed 15 percent. The bottom of the gravel aggregate must be at least 12 inches below natural grade. If the *seepage bed* is used, the maximum permissible natural slope is 5 percent, but the minimum depth to the bottom of the aggregate at the lowest side remains the same (12 inches).

If *serial distribution* (Fig. 6) is used, the maximum natural slope permitted is 20 percent and the minimum depth below natural grade to the bottom of the aggregate must be 16 inches. The system must be designed by a registered professional engineer.

Fig. 6 SERIAL DISTRIBUTION

1. May be used where standard trenches must be placed on moderately steep slopes up to 25 percent
2. Detailed engineering design required for 15 to 20 percent slopes



SHALLOW PLACEMENT ABSORPTION AREA

The shallow placement absorption area (Fig. 7) as an alternate method of effluent disposal may be used for new homes constructed on sites where the limiting zone begins between 5 and 6 feet below the surface. This method cannot be used to correct a malfunctioning system of an existing residence. The percolation rate on the site must range between 6 and 60 minutes per inch. Either the standard trench or the serial distribution system discussed on the preceding page may be used.

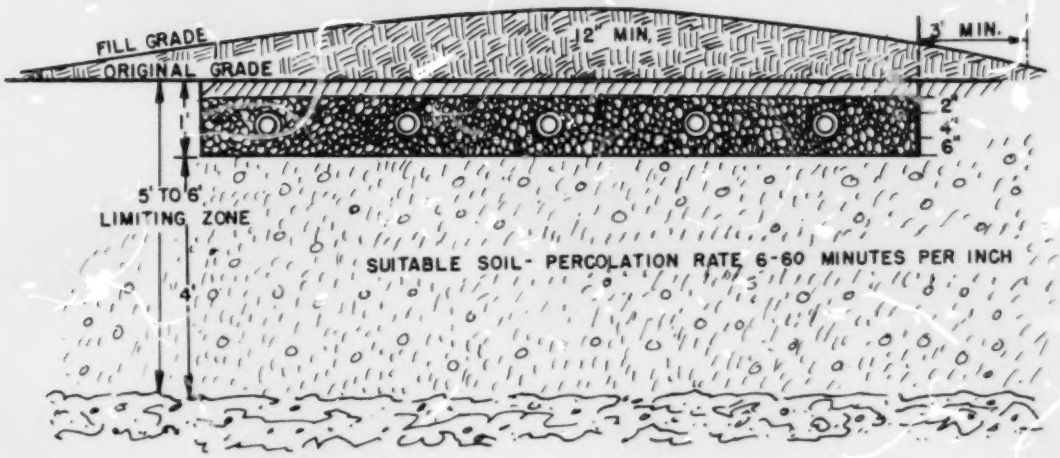
Size of Absorption Area

The size of the absorption area must conform to established standards for conventional systems. Such standards are based on site investigation, soil percolation tests, and the number of bedrooms in the home. The site used for the absorption field must have a minimum of 12 inches of suitable soil placed over the gravel aggregate and this cover must overlap the entire system by 3 feet on all sides. All surface runoff must be diverted away from the area.

Fig. 7 SHALLOW PLACEMENT AREA

Permissible Site and Soil Conditions

1. May be used where limiting zone is between 5 and 6 feet below the natural surface
2. Percolation rate must range between 6 and 60 minutes per inch
3. Site must have at least 4 feet of suitable soil between bottom of aggregate and top of limiting zone



MATRIX FOR ADAPTATION OF ALTERNATE SUBSURFACE ABSORPTION AREAS

(Adapted from Technical Manual for Sewage Enforcement Officers
Numbers in parentheses refer to comments below.)

SITUATION / ALTERNATIVE*	Existing Malfunctions—Remedial Action	Isolated Building—New Residences	Isolated Hunting, Fishing Camps	Soil Groups Where the Alternative is Permissible (2)
Elevated sand mound with septic tank	Yes	Yes (1)	Yes	1, 3, 5, 7, 9 10, 11, 12, 14
Elevated sand mound with aerobic tank	Yes (3)	Yes (1, 3)	No	1, 3, 5, 7, 9 10, 11, 12, 14
Sand-lined trenches and beds in excessively permeable soils	Yes (3)	Yes (1, 3)	Yes (4)	1, 3, 5, 7, 9
Over-size absorption area in deep soil.** *Aerobic tanks* must be used	Yes	Yes (1)	No	10
Shallow-placement area	No	Yes (1, 3)	Yes (4)	1, 3, 5, 7, 9, 11

1. There must be sufficient suitable area for replacement of this alternate subsurface absorption area with another of equivalent size and design.
2. Soil groups 2, 4, 6, 8 (soil groups are described elsewhere) are generally suitable for conventional subsurface absorption areas, but require individual on-site field investigation.
3. The size of an absorption area may be reduced by one-third when an aerobic treatment tank is used.
4. Aerobic treatment tanks not permitted.

*All alternatives indicated are acceptable for use in subdivisions and in commercial, industrial, and institutional (C-I-I) situations, except that the over-size area is not permitted for C-I-I.

**Percolation rate must be between 60 and 90 minutes per inch.

The soil series mapped in Pennsylvania by the U.S. Soil Conservation Service have been placed in fifteen groups, based on their limitations for subsurface disposal of effluent and the most probable percolation rates of those not eliminated from consideration by flooding, seasonal water table, shallowness, or special pollution hazards.

A. Soils that do not have seasonal high water table, severe flooding hazard, extreme shallowness, or limestone bedrock; grouped according to probable percolation rates.

(Group 1)

Soils with very rapid percolation with hazard from insufficient filtration and renovation of effluent.

Adams
Allegheny, course subsoil variant
Alton
Ashton
Barbour, high bottom phase
Beach sand, stabilized
Bedington
Berks, brown subsoil phase
Berks (in Berks Co. only)
Blandburg
Chavies (Dauphin Co. only)
Chagrin, high bottom phase
Chenango
Chili
Colonie
Conotton
Dune sand
Gatesburg
Hoosic
Howard
Lakin
Leetonia sand variant
Massillon
Otisville
Plainfield
Rushtown
Tunkhannock
Vanderlip
Vrooman

(Group 2)

Deep, well drained soils with probable percolation rates of 1 inch of water in 6 to 15 minutes.

Arendtsville
Clifton
Cossayuna
Duncannon
(except Bucks Co.)
Hartleton
Highfield
Kempton
Leck Kill
Leck Kill—Calvin
Ottawa
Patuxent
Swartswood
Tioga,
high bottom phase
Trexler
Troy
Unadilla
Wheeling
Wooster
Woostern

(Group 3)

Moderately deep, well drained soils with probable percolation rates of 1 inch of water in 6 to 15 minutes. (Rates are quite variable in short distances due to variations of material immediately under the soil.)

Ashby
Berks
(except Berks Co.)
Catoctin
Dilldown
Kistler
Kutztown
Manor
Nassau
Stephensburg
Trexler,
moderately shallow

(Group 4)

Deep, well drained soils with probable percolation rates of 1 inch of water in 15 to 30 minutes.

Alford
Annandale
Birdsboro
Chester
Dutchess
Elioak
Germania
Hanover
Hazelton
Lansdale
Lewisberry
Lycoming
Meadville
Mifflinburg
Morrison
Murrill,
deep phase
Myersville
Rayne
Sassafras
Sequatchie
Summerhill
Sweden
Valois
Wellston
Whiteford
Wickham
Wyoming

(Group 5)

Moderately deep, well drained soils with probable percolation rates of 1 inch of water in 15 to 30 minutes. (Rates are quite variable in short distances due to variations of material immediately under the soil.)

Brandywine
Brecknock
Cardiff
Dekalb
Leetonia
Lehew
Lordstown
Mounty Airy
Muskingum
Oquaga
Oquaga—Lackawanna
Parker
Steinsburg
Teas
Wheeling,
shallow phase

(Group 6)

Deep, well drained soils with probable percolation rates of 1 inch of water in 30 to 45 minutes.

Allegheny
Allenwood
Belmont
Brookside
Butlertown
Cassville
Chavies*
Christiana
Clymer
Edgemont
Elk
Elkinsville
Elsinboro
Fauquier
Fleetwood
Hackers
Hartsells
Haven
Holston
Howell
Juniata
Laidig
Laidig & Murrill
Lashley
Mazeppa
Mench
Pocono
Sassafras—Glenelg
Shelocta
Walton
Wayne
Waynesboro
Weatherly
Westmoreland,
deep variant
Worth

*Fayette and neighboring counties

(Group 7)

Moderately deep, well drained soils with probable percolation rates of 1 inch of water in 30 to 45 minutes. (Rates are quite variable in short distances due to variations of material immediately under the soil.)

Bucks
Calvin
Chome
Fleetwood,
shallow phase
Glenelg
Lansdale,
shallow phase
Penn
Penn—Lansdale

(Group 8)

Deep, well drained soils with probable percolation rates of 1 inch of water in 45 to 60 minutes.

Cattaraugus	Neshaminy	Quakertown	Ungers
Lackawanna	Norton	Springtown	Westfield

(Group 9)

Moderately deep, well drained soils with most probable percolation rates of 1 inch of water in 45 to 60 minutes. (Rates are quite variable in short distances due to variations in material immediately under the soil. Malfunctions may be expected in many individual cases on these soils, although the average percolation rate is satisfactory.)

Culleoka	Gilpin—Rayne	Rayne—Gilpin	Westmoreland
Gilpin	Loudonville	Summerhill—Gilpin	

(Group 10)

Well drained soils with probable percolation rates slower than 1 inch of water in 60 minutes.

Bath	Ewingville	Minora	Upshur,
Duncannon	Legore	Montalto	acid substratum
(Bucks Co. only)	Meckesville	Upshur	Upshur—Gilpin
			Vandalia

B. Soils series that are underlain by limestone and have a high hazard of ground water pollution through solution channels.

(Group 11)

Araby	Conestoga	Fogelsville	Millheim
Athol	Corydon	Frankstown	Murrill
Barree	Crestmore	Hagerstown	Opequon
Bedington—Edom	Duffield	Hollinger	Pequea
Benson	Dunmore	Hublersburg	Ryder
Birdsboro—Duffield	Edom	Letort	Vira
Brooke	Elliber	Litz	Washington
Chambersburg	Emory	Mertz	Washington,
			coarse variant

C. Well drained soils that are shallow or very shallow to bedrock.

(Group 12)

Arnot	Mehoopany	Penn*	Stony land
Klinesville	Montevallo	Ramsey	Very stony land
Manlius	Northumberland	Ramsey—Dekalb	Weikert

*Very shallow variant

D. Soil series that occur on flood plains and have a high flooding hazard. Not suitable for subsurface disposal systems.

(Group 13)

Algiers	Comus	Lobdell	Riverwash
Alluvial land	Congaree	Lorain	Rowland
Alluvial soils	Cuba	Marsh	Schuylkill
Atkins	Dunning	Melvin	Senecaville
Barbour	Elkins	Middlebury	Sloan
Basher	Hatboro	Moshannon	Tioga
Bermudian	Holly	Newark	Tipton
Bowmansville	Huntingdon	Nolin	Wallkill
Cacapon	Kerrtown	Orrville	Warners
Chagrin	Largent	Papakating	Wayland
Chewacla	Linden	Philo	Wehadkee
Clifty	Lindside	Pope	Wyalusing
Codorous			

E. Moderately well drained soils on upland sites. These soils have seasonal high water tables which are the major limitation on use for subsurface disposal systems.

(Group 14)

Albrights
Altavista
Amaranth
Bedford
Beltsville
Berrien
Blairton
Braceville
Bridgeville
Buchanan
Cambridge
Canaseraga
Canfield
Carlina
Clarksburg
Conotton*
Conowingo
Cookport
Culvers
Dewart
Dormont
Drab
Drifton
Edgemont*
Edom*
Elfort
Empeyville
Ernest
Fairfax
Ganoga
Gilpin—Wharton
Glenville
Greer
Hornell
Imler
Iredell
Iva
Kedron
Kreamer
Landisburg
Langford
Landsdowne
Lawrenceville &
Duncannon
Lawrenceville
Lehigh
Marain
Monongahela
Morehead
Mount Lucas
Painesville
Pekin
Penn & Readington
Phelps
Pierpont
Platea*
Rainsboro
Raritan
Readington
Rebuck
Scio
Sciotoville
Sedan
Stendal
Strasburg
Swartswood—Wurtsboro
Thurmont
Tisit
Titusville
Titusville—Gilpin
Trego
Unadilla & Scio
Urbana
Vandergrift
Vandergrift—Gilpin
Warrior
Watson
Wellsboro
Wharton
Wharton—Gilpin
Wharton—Upshur
Whitwell
Williamsburg
Wiltshire
Woodstown
Wurtsboro
Zoar

*moderately well drained variant

F. Somewhat poorly, poorly, and very poorly drained soils on upland sites. These soils have high water tables and are unsuitable for subsurface disposal systems.

(Group 15)

Abbottstown
Albia
Alden
Aldino
Allis
Alvira
Andover
Ariel
Armagh
Armenia
Atherton
Baile
Bartle
Birdsall
Blago
Boynton
Brinkerton
Burgin
Californ
Calvert
Canadice
Canandaigua
Caneadea
Carlisle
Cavode
Chalfont
Chillisquaque
Chilo
Chippewa
Cokesbury
Colbert
Colden
Collamer
Comly
Conyngham
Croton
Cuyler
Dalton
Dannemora
Doylestown
Dubois
Elbert
Ellery
Ellery & Alden
Erie
Evendale
Fallsington
Fredon
Fremont
Frenchtown
Ginat
Grandin
Greenwood Peat
Gresham
Griggs
Guernsey
Guernsey—Culleoka
Guthrie
Halsey
Johnsburg
Kanona
Keyport
Kreamer*
Lamington
Lawrence
Leadvale
Leonardtown
Library
Lickdale
Loysville
Luray
Lyles
Mahoning
Marengo
Markes
McGary
Miner
Montgomery
Morris
Muck
Muck & Peat
Natalie
Nolo
Norwich
Orange
Othello
Peat & Muck
Penlaw
Platea
Purdy
Ravenna
Reaville
Red Hook
Rexford
Rimer
Rittman
Roanoke
Robertsville
Rohrersville
Shallow Peat & Muck
Sheffield
Shelmadine
Stanton
Thorndale
Tidal Marsh
Towhee
Trumbull
Tughill
Tuller
Turbotville
Tygart
Tyler
Venango
Volusia
Wadsworth
Wallington
Watchung
Waterboro Muck
Wauseon
Weeksville
Williamson
Woodglen
Worsham
Zipp

*somewhat poorly drained variant

Information in this publication has been based on or adapted from the following documents.

1. *Technical Manual for Sewage Enforcement Officers* Department of Environmental Resources (DER) Commonwealth of Pennsylvania.
2. DER Rules and Regulations, *Chapter 71 Administration of Sewage Facilities Program*
3. DER Rules and Regulations, *Chapter 73 Standards for Sewage Disposal Facilities.*

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